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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/558,053 04/26/00 APYAMA

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EXAMINER

MMC2/0409

OBLON SPIVAK MCCLELLAND MAIER & NEUSTADT
1755 JEFFERSON DAVIS HIGHWAY
FOURTH FLOOR
ARLINGTON VA 22202

ART UNIT

PAPER NUMBER

2823
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Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/558,053

Applicant(s)

AOYAMA ET AL.

Examiner

Kurt M. Eaton

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 January 2001.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 28-41 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 28-41 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- 15) ☐ Notice of References Cited (PTO-892)
- 16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 18) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 19) ☐ Notice of Informal Patent Application (PTO-152)
- 20) ☐ Other: _____.

DETAILED ACTION

Specification

1. As stated in the Office Action mailed on 10/24/00, the title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 41 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Subject matter for which the specification as originally filed includes limitations found in newly added claim 41, more specifically, "wherein said step of forming said groove comprises: removing a first portion of said second insulation film to expose said third insulation film while leaving a remaining second portion of said second insulation film; and removing a third portion of said first insulation film to expose said substrate which leaving remaining fourth portion of said third insulation film".

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 28-31, 40, and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cochran.

In re claims 28 and 40, Cochran shows in Figures 1-5 forming a first insulating film (23) on a semiconductor substrate (21); forming a second insulating film (25) on the first insulating film, wherein the second insulating film is made of a material different from that of the first insulating film, has a thickness smaller than that of the first insulating film, and has a different etch selectivity with respect to the first insulating film; forming a third insulating film (27) on the second insulating film, wherein the third insulating film is made of a material different from that of the second insulating film, has a thickness larger than that of the second insulating film, and has a different etch selectivity with respect to the second insulating film; forming a groove in a region of the third insulating film, in which a wiring is to be formed, wherein the groove is formed by etching the third insulating layer and then the second insulating layer; and forming a metal wiring (37) in the groove {column 3, line 4 – column 4, line 67}.

Cochran fails to show wherein the groove has a bottom to which the second insulating film is exposed.

It would have been obvious to one of ordinary skill in the art at the time the invention was made that the groove of Cochran would have included a bottom to which the second insulating film was exposed since Cochran discloses that the second and third insulating films have different etch selectivities. Accordingly, upon forming the groove in the third insulating film of Cochran, it would have been obvious that the second insulating film would have been exposed within the groove.

In re claim 29, Cochran further includes a step of removing a part of that portion of the second insulating film which is exposed to the groove, and a part of the first insulating film under the portion of the second insulating film, and thus forming a contact hole reaching to the semiconductor substrate, wherein the contact hole is buried with a metal in the step of forming a metal wiring in the groove {column 3, line 4 – column 4, line 67}.

In re claim 30, Cochran shows wherein the first insulating film is substantially formed of SiO_2 , wherein the second insulating film is substantially formed of Si_3N_4 , and wherein the third insulating film is substantially formed of SiO_2 {column 4, lines 60-67}.

In re claim 31, Cochran shows wherein the metal wiring is formed of Al {column 3, lines 49-51}.

In re claim 41, Cochran shows wherein the step of forming the groove includes removing a first portion of the second insulation film to expose the first insulation film while leaving a remaining second portion of the second insulation film; and removing a third portion of the first insulation film to expose the substrate while leaving a remaining fourth portion of the third insulation film {column 3, line 4 – column 4, line 67}.

6. Claims 32-34, 36, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cochran in view of Mu.

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In re claims 32, 33, 36, and 37, Cochran substantially discloses the invention as claimed but fails to show the step of forming a barrier metal film of Nb on inner surfaces of the groove and the contact hole.

Mu teaches wherein a barrier layer made of Nb is formed within a groove in a dielectric layer prior to deposition of Al material within the groove {column 4, lines 38-46}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a Nb barrier layer metal film on inner surfaces of the groove and the contact hole of Cochran prior to formation of the Al metal wiring since, as evidenced by Mu, Nb is a known material that acts as a barrier layer to aluminum material and it is well known within the art that a barrier layer would help maintain the integrity of the insulating films surrounding the Al metal wiring by preventing atoms of the metal wiring from diffusing into the insulating films and the selection of a known material on the basis of its suitability for the intended use involves only routine skill in the art. Furthermore, the specification contains no disclosure of either the critical nature of the claimed material or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen materials or upon another variable recited in a claim, the applicant must show that the particular materials are critical.

In re claim 34, Cochran substantially discloses the invention as claimed but fails to show wherein the metal wiring is formed of Cu.

Mu teaches wherein Cu and Al are both known materials that may be used in metal wiring structures {column 4, lines 38-46}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the metal wiring of Cochran out of Cu instead of Al since, as evidenced by Mu, Cu is a known material that may be used in metal wiring structures and may substitute Al and the selection

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of a known material on the basis of its suitability for the intended use involves only routine skill in the art. Additionally, Cu is a known material that has a lower resistivity than Al. Thus replacing Al within the metal wiring of Cochran with Cu would increase the performance of the device.

Furthermore, the specification contains no disclosure of either the critical nature of the claimed material or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen materials or upon another variable recited in a claim, the applicant must show that the particular materials are critical.

7. Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cochran in view of Roth.

In re claim 35, Cochran further includes a step of forming a top etch stop film (29) on the third insulating film, wherein the top etch stop film is made of silicon nitride {column 3, line 4 – column 4, line 47}.

Cochran fails to show wherein the top etch stop layer is formed of carbon.

Roth teaches wherein carbon and silicon nitride are both known material that may be used as etch stop layers with respect to SiO_2 {column 3, lines 24-60}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the top etch stop layer of Cochran out of C instead of silicon nitride since, as evidenced by Roth, C is a known material that may be used as an etch stop material with respect to SiO_2 and the selection of a known material on the basis of its suitability for the intended use involves only routine skill in the art. Furthermore, the specification contains no disclosure of either the critical nature of the claimed material or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen materials or upon another variable recited in a claim, the applicant must show that the particular materials are critical.

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8. Claims 38 and 39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cochran in view of Roth as applied to claim 35 above, and further in view of Mu, as applied to claim 33 above.

Cochran in view of Roth substantially discloses the invention as claimed but fails to show further forming another barrier metal film on the metal wiring, wherein the another barrier metal film is formed of Nb.

Mu teaches wherein a barrier layer made of Nb is formed within a groove in a dielectric layer prior to deposition of Al material within the groove {column 4, lines 38-46}. Mu also teaches in Figure 9 formation of an equivalent metal wiring structure formed in the groove and in the contact hole of Cochran is repeated such that a second level of metal wiring filling a second contact hole and a second groove is formed over the first metal wiring structure {column 8, lines 39-67}.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a Nb barrier layer metal film on inner surfaces of the groove and the contact hole of Cochran in view of Roth prior to formation of the Al metal wiring since, as evidenced by Mu, Nb is a known material that acts as a barrier layer to aluminum material and it is well known within the art that a barrier layer would help maintain the integrity of the insulating films surrounding the Al metal wiring by preventing atoms of the metal wiring from diffusing into the insulating films and the selection of a known material on the basis of its suitability for the intended use involves only routine skill in the art. Furthermore, the specification contains no disclosure of either the critical nature of the claimed material or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen materials or upon another variable recited in a claim, the applicant must show that the particular materials are critical. It also would have been obvious to form another barrier metal film made of Nb on the metal wiring structure of Cochran in view of Roth and Mu by forming a second level of metal wiring structures including a second groove and a second contact

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hole since, as suggested by Mu, formation of second level metal wiring structures over previously formed metal wiring structures is well known within the art and would require only duplication of essential working steps and mere duplication of essential working steps involves only routine skill in the art.

Response to Arguments

9. Applicant's arguments received 1/26/01 have been fully considered but they are not persuasive.

10. Applicant contends Cochran et al. does not disclose the method of claim 28 because "the intent of Cochran et al. is to selectively remove the insulating films 25 and 27 leaving film 23 exposed at the bottom of the groove" while, in claim 28, "the second insulating film is exposed at the bottom of the groove".

The examiner respectfully submits that the second insulating film as claimed in claim 28 is exposed in a **groove that is formed in a region of the third insulating film**. In view of the materials disclosed in Cochran included in the second and third insulation films, Cochran shows the method of claim 28.

Conclusion

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the

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mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

12. Paper related to this application may be submitted directly to Art Unit 2823 by facsimile transmission. Papers should be faxed to Art Unit 2823 via the Art Unit 2823 Fax Center located in Crystal Plaza 4, room 4C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2823 Fax Center number is (703) 308-7722 or -7724. The Art Unit 2823 Fax Center is to be used only for papers related to Art Unit 2823 applications.

Any inquiry concerning this communication or earlier communication from the examiner should be directed to **Kurt Eaton** at (703) 305-0383 and between the hours of 8:00 AM to 4:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via kurt.eaton@uspto.gov.



OLIK CHAUDHURI
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800